

QM 23 M37H85M3 1934

MARTIN, Newell, 1854-
 The human body: its structure and activities and the conditions of its healthy working. 12th ed. by Ernest G. Martin. New York, H. Holt [1934] xv, 701p. illus. 21cm.

1. Corps humain 2. Physiologie QP 34
 M37 H85 M3 I. Martin, Ernest Gale,
 1876- II. T.

122,155

THE HUMAN BODY

ITS STRUCTURE AND ACTIVITIES AND THE
 CONDITIONS OF ITS HEALTHY WORKING

BY

H. NEWELL MARTIN

*Late Professor of Biology in the Johns Hopkins University
 and of Physiology in the Medical Faculty
 of the same*

TWELFTH EDITION

BY

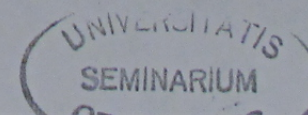
ERNEST G. MARTIN

*Professor of Physiology in Leland Stanford
 Junior University*



UNIVERSITAS S. PAULI 233 MAIN, OTTAWA

NEW YORK
 HENRY HOLT AND COMPANY



14.1

COPYRIGHT, 1934,
BY
HENRY HOLT AND COMPANY, INC.

COPYRIGHT, 1937,
BY
RUBY T. MARTIN

6-46

PRINTED IN THE
UNITED STATES OF AMERICA

PREFACE TO TWELFTH EDITION

IN the twelfth edition, as in previous revisions, an earnest effort has been made to incorporate all the important new discoveries in physiology. As new discoveries are made, reinterpretation of the way in which various bodily functions are carried on becomes necessary. This has been true notably in respect to cerebral functioning, the account of which has been completely rewritten to bring it into harmony with the large amount of very important work on nervous conduction that has been done within the last few years. A chapter has been added on hormones to permit inclusion of the new discoveries regarding these important substances. The chapter on voice and speech has been incorporated with the chapter on the ear and hearing, experience having shown that voice production can be taught most conveniently in connection with the study of the sense of hearing. At the suggestion of Professor R. J. Seymour of the Ohio State University, to whom I am deeply indebted for much helpful criticism, the section on histology has been revised to make it accord with modern practice, and the material on digestion has been rearranged in the hope of simplifying the teaching of the subject. Among other users of the book to whom I am indebted for helpful suggestions I wish to mention particularly Professor George D. Shafer of this University, who has called my attention to numerous points at which presentation could be improved for teaching purposes. A number of new cuts have been introduced. Acknowledgment of the source of most of these is included in their respective legends, all new cuts which do not carry such acknowledgment are from *The Elements of Physiology* by Martin and Weymouth, Lea and Febiger, publishers.

E. G. M.

STANFORD UNIVERSITY
February, 1934

PREFACE TO THE FIRST EDITION

IN the following pages I have endeavored to give an account of the structure and activities of the Human Body, which, while intelligible to the general reader, shall be accurate, and sufficiently minute in details to meet the requirements of students who are not making Human Anatomy and Physiology subjects of special advanced study. Wherever it seemed to me really profitable, hygienic topics have also been discussed, though at first glance they may seem less fully treated of than in many School or College Text-books of Physiology. Whoever will take the trouble, however, to examine critically what passes for Hygiene in the majority of such cases will, I think, find that, when correct, much of it is platitude or truism: since there is so much that is of importance and interest to be said it seems hardly worth while to occupy space with insisting on the commonplace or obvious.

It is hard to write a book, not designed for specialists, without running the risk of being accused of dogmatism, and some readers will, no doubt, be inclined to think that, in several instances, I have treated as established facts matters which are still open to discussion. General readers and students are, however, only bewildered by the production of an array of observations and arguments on each side of every question, and, in the majority of cases, the chief responsibility under which the author of a text-book lies is to select what seem to him the best supported views, and then to state them simply and concisely: how wise the choice of a side has been in each case can only be determined by the discoveries of the future.

Others will, I am inclined to think, raise the contrary objection that too many disputed matters have been discussed: this was deliberately done as the result of an experience in teaching Physiology which now extends over more than ten years. It would have been comparatively easy to slip over things still uncertain and subjects as yet uninvestigated, and to represent our knowledge of the workings of the animal body as neatly rounded off at all its contours and complete in all its details — *totus, teres, et rotundus*. But by so doing no adequate idea of the present state of physi-

ological science would have been conveyed; in many directions it is much farther traveled and more completely known than in others; and, as ever, exactly the most interesting points are those which lie on the boundary between what we know and what we hope to know. In Gross Anatomy there are now but few points calling for a suspension of judgment; with respect to Microscopic Anatomy there are more; but a treatise on Physiology which would pass by, unmentioned, all things not known but sought, would convey an utterly unfaithful and untrue idea. Physiology has not finished its course. It is not cut and dried, and ready to be laid aside for reference like a specimen in an Herbarium, but is comparable rather to a living, growing plant, with some stout and useful branches well raised into the light, others but part grown, and many still represented by unfolded buds. To the teacher, moreover, no pupil is more discouraging than the one who thinks there is nothing to learn; and the boy who has "finished" Latin and "done" Geometry finds sometimes his counterpart in the lad who has "gone through" Physiology. For this unfortunate state of mind many Text-books are, I believe, much to blame: difficulties are too often ignored, or opening vistas of knowledge resolutely kept out of view: the forbidden religions may be, it is true, too rough for the young student to be guided through, or as yet pathless for the pioneers of thought; but the opportunity to arouse the receptive mental attitude apt to be produced by the recognition of the fact that much more still remains to be learned — to excite the exercise of the reasoning faculties upon disputed matters — and, in some of the better minds, to arouse the longing to assist in adding to knowledge, is an inestimable advantage, not to be lightly thrown aside through the desire to make an elegantly symmetrical book. While I trust, therefore, that this volume contains all the more important facts at present known about the working of our Bodies, I as earnestly hope that it makes plain that very much is yet to be discovered.

A work of the scope of the present volume is, of course, not the proper medium for the publication of novel facts; but, while the "Human Body," accordingly, professes to be merely a compilation, the introduction of constant references to authorities would have been out of place. I trust, however, that it will be found throughout imbued with the influence of my beloved master, Michael Foster; and on various hygienic topics I have to acknowledge

a special indebtedness to the excellent series entitled *Health Primers*.

The majority of the anatomical illustrations are from Henle's *Anatomie des Menschen*, and a few from Arendt's *Schulatlas*, the publishers of each furnishing electrotypes. A considerable number, mainly histological, are from *Quain's Anatomy*, and a few figures are after Bernstein, Carpenter, Frey, Haeckel, Helmholtz, Huxley, McKendrick, and Wundt. About thirty, chiefly diagrammatic, were drawn specially for the work.

Quantities are throughout expressed first on the metric system, their approximate equivalents in American weights and measures being added in brackets.

H. N. M.

BALTIMORE, October, 1880.

CONTENTS

CHAPTER	PAGE
<p>I. THE GENERAL STRUCTURE AND COMPOSITION OF THE HUMAN BODY</p> <p>Definitions. Tissues and organs. Histology. Zoölogical position of man. The vertebrate plan of structure. The mammalia. The limbs. Microscopic structure of the Body. Chemical composition of the Body. Elements composing the Body</p>	3
<p>II. NATURE AND PROPERTIES OF LIVING PROTOPLASM</p> <p>The essence of life. Metabolism. Character of metabolic reactions. Oxidations. Biological oxidation. Enzymes. Enzymes in biological oxidation. Vitamins. The organization of protoplasm. Protoplasmic energy. Basic metabolism. Cell membranes. Inter cellular spaces and inter cellular fluids. Filtration, osmosis, dialysis. Growth metabolism. Functional metabolism. Co-ordination in the Body</p>	22
<p>III. TISSUES, ORGANS, AND PHYSIOLOGICAL SYSTEMS</p> <p>Development. The physiological division of labor. Tissues. The combination of tissues to form organs. Physiological systems. The relation of man to his environment. Adjustive systems. Maintenance systems. Animals compared with plants</p>	37
<p>IV. THE SUPPORTING TISSUES</p> <p>Connective tissue. Cartilage. Bone. The vitamin factor in bone formation. The relation of bone lime to Body lime. Size-regulating hormone. Hygienic remarks</p>	49
<p>V. THE SKELETON</p> <p>Exoskeleton and endoskeleton. The bony skeleton. Peculiarities of the human skeleton. Articulations. Joints. Hygiene of the joints</p>	61
<p>VI. THE STRUCTURE OF THE MOTOR ORGANS</p> <p>Motion in animals. The muscles. Histology of skeletal muscle. Structure of the smooth muscles. Cardiac muscular tissue. Ciliated cells</p>	84
<p>VII. MUSCULAR ACTIVITY</p> <p>The study of isolated muscles. The necessity of stimulation. A simple muscular contraction. The influence of increasing stimulation strength. The influence of temperature. Heat rigor and rigor mortis. The measure of muscular work. Influence of the form of the muscle on its working power. The source of muscular energy. The energy relationships of con-</p>	

CHAPTER	PAGE
tracting muscle. Muscular efficiency. Energy units. The energy output of muscle. The initial chemistry of contraction. The metabolic sequence in contraction. Oxygen lack. Summary of the contraction process. The beneficial effect of exercise. Fatigue of muscle. Contracture. Tetanus. Voluntary muscular contraction. The electrical phenomena of muscle. Physiology of smooth muscle. Mechanism of contraction of smooth muscle. Physiology of cardiac muscle	94
VIII. THE USE OF MUSCLES IN THE BODY	
The special physiology of the skeletal muscles. Levers in the Body. Loss to the muscles from the direction of their pull. The equilibrium of opposing muscles. Functional muscle groups. Postures. Locomotion. Prehension. Hygiene of the muscles. Varieties of exercise	120
IX. ANATOMY OF THE NERVOUS SYSTEM	
General statement. Nerve impulses. Neurons. Synapses. The myelin sheath. The central and peripheral nervous systems. Membranes of the central nervous system. Ventricles of the brain and central canal of the spinal cord. Cerebrospinal fluid. The spinal cord. The brain. The spinal nerves. Cranial nerves. White and gray matter. The sympathetic or autonomic system	136
X. GENERAL PHYSIOLOGY OF THE NERVOUS SYSTEM. REFLEXES	
Conduction within single neurons. Nature of the nerve impulse. Fatigue. Reflexes. Anatomical arrangement. Irreversible conduction. How are nerve paths determined? Action of strychnine. The more complex reflexes. Inhibition. Stimulus patterns and response patterns. Inherent reflexes in animals and man. Instincts. Relation of the brain to the head senses. Special significance of the distance receptors. The cerebrum provides machinery for selection	156
XI. STRUCTURE, NERVE CONNECTIONS, AND FUNCTIONS OF THE CEREBRUM	
A normal animal compared with a "reflex" one. The cerebrum dependent on the receptor system. Afferent paths of the cerebrum. Tracing nerve paths. Paths of the various senses. General structure of the cerebrum. Cortical localization. Cortical "reflex" paths. Conditioned reflexes. Natural conditioning. Memory. Relation of consciousness to cortical activity. Attention. Idea formation. Volition. Expression of ideas in action. Habitual actions. Language. Emotions. Nourishment of the brain	172
XII. LOCOMOTION; THE AUTONOMIC NERVOUS SYSTEM; FATIGUE; SLEEP; THYROID	
Locomotion. Sensory basis of locomotion. Tonus. Structure and connections of the cerebellum. Postural reflexes. The brain stem (medulla and midbrain). Autonomic or sympathetic system. Effect of nicotine. Reflex control of the autonomic system. Grand divisions of the autonomic system.	

CHAPTER	PAGE
Significance of sympathetic and parasympathetic functions. This an emergency mechanism. Relation of the autonomic systems to emotional states. Neuro-muscular fatigue. Sleep. Waking. Hormones of the nervous system. Adrenin. Action of adrenin. The thyroid. Thyroxin. Function of thyroxin. Hypothyroidism. Hyperthyroidism	202
XIII. THE RECEPTOR SYSTEM. INTERNAL AND CUTANEOUS SENSATIONS	
The receptor system. The differences between sensations. The psychophysical law. Adaptation. Classification of receptors. The muscle sense. Hunger. Thirst. Cutaneous receptors. Pain. Touch. The localizing power of the skin. Temperature sense. Place of tactile sensations in the mental life. Peripheral reference of sensations. Perceptions. Illusions	219
XIV. THE EAR. HEARING AND EQUILIBRATION. VOICE. TASTE AND SMELL	
Functions of the ear. Sounds. Sympathetic resonance. The external ear. Functions of the tympanic membrane. The middle ear. Auditory ossicles. Internal ear. Bony labyrinth. Membranous labyrinth. Organ of Corti. Function of the cochlea. Judgments of direction and distance of sounds. Voice. The larynx. The vocal cords. The muscles of the larynx. Voice range. Vowels. Consonants. The equilibrium organ. Function of the semicircular canals. Relation of the vestibule to the equilibrium sense. Taste. Smell	239
XV. THE EYE AS AN OPTICAL INSTRUMENT	
The essential structure of an eye. Appendages of the eye. Lachrymal apparatus. Muscles of eye. Anatomy of eyeball. Optic nerves, chiasma, and tracts. Retina. Refracting media of the eye. Ciliary muscle. Properties of light. Refraction. Wide range of clear vision in the resting eye. Accommodation. Defects of the eye. Hygiene of the eyes.	269
XVI. THE EYE AS A SENSORY APPARATUS	
The excitation of the visual apparatus. Intensity of visual sensations. Function of the rods. Visual purple. Duration of luminous sensations. Localizing power of the retina. Color vision. Function of the cones. Distribution of color sense over the retina. Color blindness. After images and contrasts. Theories of color vision. Visual perceptions. Vision with two eyes. Perception of solidity	293
XVII. THE STRUCTURE AND FUNCTIONS OF TISSUE FLUID. BLOOD AND LYMPH	
The external medium. The internal medium. Blood. Lymph. Lacteals. Composition of blood. Red corpuscles. Hemoglobin. Origin and fate of the red corpuscles. Anemia. Nucleated blood cells. Spleen. Function of reticulo-endothelial tissues. Blood platelets. Plasma. Neutrality preservation. Quantity of blood. Histology and chemistry of lymph	316

CHAPTER	PAGE
XVIII. THE DISEASE-RESISTING FUNCTION OF THE BLOOD. BLOOD CLOTTING	
Infection. Nucleated blood-cells resist infection. Immunity. Antigens. Consequences of antigen-antibody reaction. Cellular immunity. Course of infection. Neutralization of toxin by anti-toxin. Protective inoculation. Carriers. Anaphylaxis. Protein sensitiveness in man. Clotting of blood. Uses of clotting. Source of blood-fibrin. Thrombin. Prevention of clotting. Role of blood-platelets. Summary of clotting. Methods of hastening or retarding clotting. "Bleeders." Blood transfusion. Blood groups.	334
XIX. THE ANATOMY OF THE HEART AND BLOOD VESSELS	
General statement. Position of heart. Membranes of heart. Cavities of heart. Anatomy of heart. Valves of heart. Arterial system. Capillaries. Veins. Pulmonary circulation. Course of blood. Portal circulation. Arterial and venous blood. Structure of vessels	354
XX. THE ACTION OF THE HEART. THE REGULATION OF THE HEART BEAT	
Beat of the heart. Cardiac impulse. Relations of nerve and muscle elements within the heart. Physiological peculiarities of heart. Passage of beat over the heart. Heart block. Events occurring within heart during a cardiac cycle. Use of the papillary muscles. Sounds of the heart. Action of the heart valves. Effects of valvular insufficiency. Function of the auricles. Ventricular output and blood-flow per minute. Work done by the heart. Extrinsic nerves of the heart. Inhibitory and augmentor centers	369
XXI. THE CIRCULATION OF THE BLOOD. BLOOD PRESSURE AND BLOOD VELOCITY. THE PULSE	
Flow of blood outside of heart. Circulation seen in frog's web. Resistance to blood-flow. Conversion of intermittent into continuous flow. Arterial pressure. The pulse. Blood pressure in man. Rate of blood-flow. Venous pressure. "Law of the Heart." Significance of Bainbridge Reflex. Source of venous pressure. Effect of gravity. Influence of muscular movements. Aspiration of the thorax.	387
XXII. THE VASOMOTOR AND VENOMOTOR MECHANISMS. DETAILS OF CAPILLARY BLOOD-FLOW. TRAUMATIC SHOCK. THE LYMPHATIC SYSTEM	
Distribution of blood among various parts of the body. Nerves of blood vessels. Vasoconstrictor nerves. Vasoconstrictor center. Control of vasoconstrictor center. Depressor nerve. Vasodilator nerves. Vasodilator center. Relation of vasomotor tone to cerebral activity. Adrenin. Capillary walls independently contractile. Capillaries open and close in rotation. Special capillary dilators. Traumatic shock. The venomotor mechanism. Abdominal vascular relaxation. The lymphatic system. Structure of lymph-vessels. The thoracic duct. Lymph nodes. Functions of lymph-nodes. Tonsils and adenoids. Movement of the lymph. Lymphagogues	404

CHAPTER	PAGE
XXIII. RESPIRATION. THE MECHANISM AND REGULATION OF BREATHING	
Definitions. Respiratory organs. Air-passages and lungs. Structure of trachea and bronchi. Structure of lungs. Pleura. Breathing movements. Structure of thorax. Changes in size of thorax. Expiration. Forced breathing. Respiratory sounds. Capacity of lungs. Types of breathing. Aspiration of thorax. High pressure in the chest. Respiratory center. Eupnea, hyperpnea, dyspnea, apnea. Holding breath. Asphyxia. Artificial respiration. Anoxemia. Acclimatization. Modified respiratory movements	420
XXIV. RESPIRATION. THE GASEOUS INTERCHANGES	
Nature of the problems. Changes produced in air by being breathed. Ventilation. Changes undergone by the blood in the lungs. Blood gases. Laws governing the absorption of gases by a liquid. The absorption of oxygen by the blood. Hemoglobin of arterial blood nearly saturated. The general oxygen interchanges in the blood. Carbon dioxide in blood. Coal gas poisoning	446
XXV. FOODS: THEIR CLASSIFICATION. VITAMINS	
What constitutes food. Function of food. Classes of foods. Occurrence of nutrients in food. Inorganic essential accessories. Vitamins. Occurrence of occasional accessories in food. Nutrients. Mixed foods. Eggs. Milk. Vegetable foods. Composition of foods. Alcohol. Tea, coffee, cocoa. Food poisoning	463
XXVI. THE ALIMENTARY CANAL AND ITS APPENDAGES	
General arrangement. Subdivisions of the canal. Mouth. Teeth. Tongue. Salivary glands. Pharynx. Esophagus. Stomach. Small intestine. Large intestine. Nerves of intestines. Liver. Pancreas. Blood vessels of canal	480
XXVII. CHEMICAL AND SECRETORY FACTORS IN DIGESTION	
The object of digestion. Nature of digestive process. Source of digestive enzymes. Organs of secretion. Forms of glands. Secretory process. Nervous control of secretory process. Hormone control of gland activity	500
XXVIII. DIGESTION IN MOUTH AND STOMACH	
Mastication. Saliva. Hygiene of the mouth. Deglutition. Entry of food into stomach. Movements of stomach. Gastric juice. Control of gastric secretion. Gastrin evokes supplementary secretion. Anacidity. Importance of the stomach. Emptying of stomach	507
XXIX. DIGESTION IN THE INTESTINES	
Movements of small intestines. Extrinsic control of stomach and intestinal movements. Pancreatic juice. Control of pancreatic secretion. Bile. Action of gall bladder. Succus entericus. Flow of intestinal juice. Summary of the digestive process. Prevention of self-digestion. Digestive history of a meal. Maintenance of good digestion. Movements of the large in-	

CHAPTER	PAGE
testine. Bacterial action. Importance of roughage. Cause of constipation symptoms	523
XXX. THE ABSORPTION AND USE OF FOODS	
General statement. Absorption from the stomach. Absorption in small intestine. Nature of the absorptive process. Channels of absorption. Absorption and temporary storage of carbohydrates. Storage of glycogen in the muscles. Relation of kidney to the concentration of sugar in blood. Alimentary glycosuria. Other types of glycosuria. Diabetes mellitus. Insulin. Relation of insulin deficiency to glycosuria. Absorption of proteins. Absorption of fats. Absorption from the large intestine. Food requirement of the Body. Protein requirement of Body. Maintenance proteins and growth proteins. Fuel proteins. Liberation of energy in Body. Basal metabolism. Metabolism of muscular work. Relative food values of proteins, carbohydrates and fats. Specific dynamic action of nutrients. Nutritive value of gelatin. Special metabolism of fats. Principles of dietetics. Maintenance of constant weight. Water equilibrium. Nitrogen equilibrium. Carbon equilibrium. Influence of thyroid hormone upon metabolism. Treatment for obesity	534
XXXI. HORMONES	
Endocrine glands. Thyroid gland. Thyroxin. Dependence of thyroid function on iodine supply. Goiter. Treatment with iodized salt and thyroxin. Parathyroid bodies. Parathyrin. Suprarenal capsules or adrenals. Cortin. The Islands of Langerhans. Insulin. Discovery of Insulin. Physiological control of insulin secretion. The pituitary body. Hormones of anterior pituitary. Postpituitary hormones. Gonadal hormones	561
XXXII. EXCRETION AND THE EXCRETORY ORGANS. THE SKIN	
Exogenous and endogenous excreta. The channels of excretion. Liver as an excretory organ. General arrangement of the urinary organs. Naked eye structure of the kidneys. Minute structure of the kidney. Blood-flow through the kidney. Renal excretion. Normal urine. Urea. Creatinine. The purin bodies. The urinary salts. Action of kidneys in neutrality preservation. Action of different parts of an uriniferous tubule. Function of the glomeruli. Functions of the convoluted tubules. Threshold substances. Relation of renal blood-flow to the secretion of urine. Diuretics. The epidermis. The corium, dermis, or true skin. Hairs. Nails. Glands of the skin. Skin secretions. Nervous and circulatory factors in the sweat secretion. Sebaceous secretion. Hygiene of the skin. Bathing	571
XXXIII. HEAT PRODUCTION AND REGULATION	
Cold- and warm-blooded animals. Temperature of the body. Sources of animal heat. Maintenance of a uniform temperature. Factors influencing heat-loss. Factors influencing heat-production. Fever. Clothing. Common colds	597
XXXIV. REPRODUCTION	
Reproduction in general. Cell-division. Germ-cells compared with tissue-cells. Sexual reproduction. Maturation of	

CHAPTER	PAGE
germ-cells. Heredity. Sex determination. Sex-linked characters. Accessory reproductive organs. Male reproductive organs. Seminal fluid. Reproductive organs of the female. Microscopic structure of the ovary. Mammalian ovum. Ovulation. Menstruation. Hygiene of menstruation. Sex hormones. Anterior pituitary sex hormone. Male gonadal hormone. Puberty in males. Follicular hormone. "Breeding season." Oestrin. Lutein. Sexual cycle. Fertilization. Pregnancy. Pregnancy urine. Intra-uterine nutrition of the embryo. Parturition. Lactation. Stages of life. Death	605
APPENDIX	
SUGGESTIONS FOR LABORATORY WORK	637
INDEX	681

CHAPTER I

THE GENERAL STRUCTURE AND COMPOSITION OF THE HUMAN BODY

Definitions. The living Human Body may be considered from either of two aspects. Its structure may be especially examined, and the forms, connections and mode of growth of its parts be studied, as also the resemblances or differences in such respects which appear when it is compared with other animal bodies. Or the living Body may be more especially studied as an organism presenting definite properties and performing certain actions; and then its parts will be investigated with a view to discovering what duty, if any, each fulfills. The former group of studies constitutes the science of Anatomy, and in so far as it deals with the Human Body alone, of *Human Anatomy*; while the latter, the science concerned with the uses — or in technical language the *functions* — of each part is known as *Physiology*. Closely connected with physiology is the science of *Hygiene*, which is concerned with the conditions which are favorable to the healthy action of the various parts of the Body; while the activities and structure of the diseased Body form the subject matter of the science of *Pathology*.

Tissues and Organs. Histology. Examined merely from the outside our Bodies present a considerable complexity of structure. We easily recognize distinct parts as head, neck, trunk and limbs; and in these again smaller constituent parts, as eyes, nose, ears, mouth; arm, forearm, hand; thigh, leg and foot. We can, with such an external examination, go even further and recognize different materials as entering into the formation of the larger parts. Skin, hair, nails and teeth are obviously different substances; simple examination by pressure proves that internally there are harder and softer solid parts; while the blood that flows from a cut finger shows that liquid constituents also exist in the Body. The conception of complexity which may be thus arrived at from external observation of the living, is greatly extended by dissection of the dead Body, which makes manifest that it consists of a



The **Margaret Eaton School Digital Collection** is a not-for-profit resource created in 2014-2015 to assist scholars, researchers, educators, and students to discover the Margaret Eaton School archives housed in the Peter Turkstra Library at Redeemer University College. Copyright of the digital images is the property of Redeemer University College, Ancaster, Canada and the images may not be copied or emailed to multiple sites without the copyright holder's express written permission. However, users may print, download, or email digital images for individual non-commercial use. To learn more about this project or to search the digital collection, go to <http://libguides.redeemer.ca/mes>.